Product market competition and efficiency of corporate tax management

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Abstract

Purpose – The purpose of this paper is to test the economic theory that product market competition should enhance firm performance in the US corporate tax management setting. It identifies one mechanism through which corporate management can improve firm performance. The paper also identifies business conditions that may facility or impede effective corporate tax management.
Design/methodology/approach – The paper tests the relationship between product market competition and corporate tax efficiency using large archival data. The primary data source is COMPUSTAT, which contains annual and quarterly accounting data for US public firms. Other data sources include accounting comparability data generously shared by Professor Vedi.
Findings – The paper finds that firms in competitive industries are more efficient in managing taxes. Specifically, the paper documents that firms in competitive industries exhibit lower effective tax rates than their non-competitive counterparts. Furthermore, the paper finds that the positive link between competition and the efficiency of tax management is much stronger for firms with lower cash flow volatility and for firms with fewer industry investment opportunities. The lack of financial statement comparability may weaken this link.
Research limitations/implications – Tax laws vary greatly from country to country. Readers should interpret the results within the US tax environments.
Practical implications – Results in this paper have implications for multinational corporations that are interested in investing and doing business in the USA.
Originality/value – This paper sheds light on how competition influences firm performance through efficient tax management, a specific mechanism through which competition improves firm performance. To the best of the author's knowledge, this study provides the first documentation of how product market competition affects tax planning for US publicly traded companies.

Keywords Tax planning, Firm performance

Paper type Research paper

1. Introduction

Many people believe that competition is the driving force behind efficiency and innovation. Intense product market competition exerts downward pressures on costs, reduces managerial slack, provides incentives for the efficient organization of production, and consequently should increase firm performance. While this belief has received some theoretical support (e.g. Hart, 1983; Schmidt, 1997; Raith, 2003), the empirical evidence that product market competition improves firm performance is rather limited (e.g. Nickell, 1996; Giroud and Mueller, 2010). In this paper, we investigate the effect of product market competition on the efficiency of corporate tax management. More specifically, we examine how competitive pressures affect corporate tax planning (i.e. tax avoidance)[1].

Taxes represent a significant cost of doing business. Under the tax regime in my sample period, US firms may need to transfer more than one-third of their pre-tax income to the federal, state and local governments. For many US firms, income tax expense is the second largest expense item on their income statements. Investors view low-tax firms as better controlling costs than their high-tax counterparts (Swenson, 1999). As intense competition exerts significant downward pressures on costs, firms in a more competitive environment should have stronger incentives to lower their income tax burdens through efficient tax management.

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However, *ex ante* it is unclear whether competition improves tax efficiency. Firms must comply with the federal, state, local and international tax laws to do business in various jurisdictions. Business entities, especially large- and medium-sized business entities, are subject to IRS' close monitoring and ongoing audit. Firms may have limited flexibility to manage taxes due to the "mandatory" nature of such expenses. Furthermore, firms in monopoly industries may have greater ability to manage taxes due to their profitability and monetary power. These monopolists could use their "deep" pockets to lobby for favorable tax breaks and hire top tax advisors to implement sophisticated tax strategies.

We use a large sample of US public firms to test the relationship between product market competition and firm-level tax performance. We obtain three sets of results. First, consistent with the notion that competition enhances firm performance, we document that firms operating in a more competitive environment exhibit lower effective tax rates than their less competitive counterparts. This result holds before and after controlling for factors associated with the extent of tax avoidance: profitability, leverage, growth, foreign operations, capital intensity, intangible intensity and net operating loss (*NOL*). Including those controls ensures that the documented difference in effective tax rates between competitive firms and less competitive firms is not driven by other firm fundamentals. The positive link between product market competition and tax avoidance holds in both the pre- and post-financial crisis period. In terms of economic significance, we find that the average cash effective tax rate of firms in competitive industries is about 2 percent lower than that of their non-competitive counterparts.

Furthermore, we find that the link between competition and tax avoidance is much stronger for firms with low cash flow volatility. High cash flow volatility triggered by intense competition may constrain a firm's ability to do effective tax planning in two ways: first, high cash flow volatility makes it difficult for firms to accurately forecast their future taxable income; second, high cash flow volatility may also reduce a firm's willingness to pay significant out-of-pocket tax planning fees. Consistent with these arguments, we find that the effect of competition on tax avoidance is much stronger for the subset of firms with low cash flow volatility.

We also find that the association between product market competition and tax avoidance is more pronounced for firms with low industry investment opportunities. This is consistent with the notion that firms in high-growth industries can maintain profitability by investing in profitable new projects; firms in low-growth industries place greater emphasis on cost reduction and improvement in efficiency. The association between product market competition and tax avoidance is weaker for firms lack of financial statement comparability, which suggests that the quality of accounting information system may constrain firms' ability to engage in effective tax planning.

Finally, we investigate whether increased regulation and increased tax enforcement alter the relation between competition and tax avoidance. The sub-sample period (2003–2008) is marked by ever-evolving regulatory changes (see Section 5 for more discussion). Under this "high-regulation" regime, tax departments may shift their emphasis from tax planning to tax compliance and tax risk management. However, the results show that firms in competitive industries exhibit greater level of tax avoidance under both the low- and the high-regulation regimes. Further analysis shows that competitive firms are not more likely to use aggressive tax planning strategies to lower their tax burdens than their non-competitive counterparts. Thus, if increased regulation and increased tax enforcement aim to curb abusive tax sheltering rather than reduce the competitiveness of US business entities, they should have limited impact on tax efficiency achieved through other strategies.

This paper makes several contributions. First, it increases our understanding of how product market competition influences firm performance. Several studies in the accounting literature suggest that product market competition may affect firm performance due to the provision of stronger managerial incentives or the sharpening of incentive effects

(e.g. DeFond and Park, 1999; Karuna, 2007), but little research directly examines the performance consequences of competition. This paper sheds light on how competition influences firm performance through efficient tax management, a specific mechanism through which competition improves firm performance. To the best of our knowledge, this study provides the first documentation of how product market competition affects tax planning for US publicly traded companies.

This paper also contributes to the tax accounting literature. Existing research on tax planning/tax avoidance mainly focuses on the effects of firm-level and executive-level characteristics or organization form on corporate tax behavior. We extend this line of research by investigating the effect of industry structure on corporate tax reporting. Policy makers and researchers should be interested in the negative association between product market competition and effective tax rates for US publicly traded companies documented in our study. Increased competition may be partially responsible for increased level of tax avoidance.

Several papers are related to our study. Kubick *et al.* (2015) examined within-industry variations in corporate tax avoidance. They found that industry leaders engage in more tax avoidance. Their findings are consistent with the notion that product market power allows firms to maintain higher, smoother and more persistent profitability; market leaders are more willing to pursue riskier tax avoidance strategies than their followers. Our paper differs from Kubick *et al.* (2015) in important ways. We examine cross-industry variations in corporate tax management. We are interested in how business environments, competition pressures from product markets in particular, affect the efficiency of business operations. Product market competition serves as a strong external governance mechanism and encourages managers to improve firm performance through effective tax planning. Another related study, Cai and Liu (2009), examine the effect of competition on corporate tax practices for Chinese industrial firms. In a business environment characterized by intense competition, Chinese firms reduce tax payments mainly through tax evasion. Cai and Liu (2009) contributed to the literature by documenting the dark side of competition – competition leads to unethical behavior in a developing economy. Our paper contributes to the literature by providing empirical evidence that competition improves firm performance through efficient tax planning in a developed economy[2].

Finally, Li (2010) and Dhaliwal *et al.* (2014) examined the impact of product market competition on firms' choice of financial reporting and disclosure. Our study takes a similar approach to measuring product market competition.

The remainder of the paper is organized as follows. Section 2 reviews the literature and develops hypothesis. Section 3 presents research method. Section 4 presents main results. Section 5 conducts additional analysis. Section 6 performs robustness checks. Section 7 concludes.

2. Literature review and hypothesis development

Economic theory suggests that product market competition should reduce managerial slack and improve firm performance. Much of prior research focuses on the effect of product market competition on executives (e.g. DeFond and Park, 1999) or executive compensation contracts (e.g. Karuna, 2007); however, relatively little research directly examines the impact of product market competition on firm performance. There are exceptions. Using a sample of UK manufacturing firms, Nickell (1996) found that competition is associated with higher rates of total factor productivity growth. A more recent study, Giroud and Mueller (2010) provided empirical evidence that competition enhances firm performance by reducing managerial slack. Specifically, they found that firms in non-competitive industries experience a significant drop in operating performance after the passage of business combination laws, while firms in competitive industries experience no such effect. However, we know little about the specific mechanisms through which firms achieve their

performance targets. Our study seeks to provide the first systematic evidence on how competition affects firm performance through efficient tax planning.

For three reasons, evidence on performance consequences of product market competition in the corporate tax management setting is particularly interesting. First, corporate tax function plays an increasingly important role in a business organization. Through effective tax planning and other value-added activities, corporate tax departments can help their business organizations improve cash flows and financial reporting performance. Second, both anecdotal evidence and academic research suggest that effective management of corporate tax rates has significant valuation implications (e.g. Levenson, 1999; Wilson, 2009; Wang, 2010). For example, Levenson (1999, p. 16) stated:

> [Certain] strategies […] can help companies reduce their effective tax rates from typical 35 to 40 percent to as low as 10 percent. This reduction translates to higher earnings per share and ultimately places companies in a more favorable light with analysts when compared to competitors.

The valuation implications of efficient tax management are especially important for firms in competitive industries. Firms with consistently low cash effective tax rates can reduce transfers to the governments and thus generate greater after-tax cash flows, which may partially offset the negative valuation impact such as increased profit volatility and higher bankruptcy risks induced by intense product market competition.

There are at least two channels through which competition can increase managerial effort. First, in an environment where many firms operate and compete, there are greater opportunities to compare managerial performance. Thus, firm owners are better informed about their managers' effort (e.g. Hart, 1983)[3][4]. Second, competition increases bankruptcy risks. To save their jobs, managers are expected to exert greater effort to avert bankruptcy threat (e.g. Schmidt, 1997). Consequently, in a competitive environment, managers are under constant pressures to reduce costs, including tax expenses and improve efficiency.

Tax represents a significant cost of doing business. Under the US tax regime in my sample period, the combined statutory tax rate, which reflects federal, state and local taxes, can be as high as 40 percent. To survive and maintain profitability, in a competitive environment, firms should have stronger incentives to lower income tax expenses through effective tax planning activities. To gain a competitive edge, managers in a competitive environment are also under greater pressures to seek innovative ways, including implementing innovative tax strategies, to run their business. The view that competition encourages innovation has received some empirical support in the industry organization literature (e.g. Nickell, 1996; Knott and Posen, 2009). In the accounting literature, Higgins *et al.* (2015) found that firms focusing on innovation and change indeed exhibit higher level of tax avoidance. Consequently, firms in a competitive environment may place greater emphasis on innovation; in an "innovative" culture, tax departments are more willing to pursue innovative tax planning strategies.

To summarize, in competitive industries, firms are under greater pressures to cut tax expenses through effective and innovative tax planning. This leads to our main hypothesis:

H1. Firms operating in competitive industry product markets exhibit greater efficiency in tax management than firms operating in less competitive product markets.

The argument that product market competition enhances tax efficiency is intuitively appealing. However, we may not observe the positive link between product market competition and tax avoidance. First, income tax expenses are "statutory" costs in nature, which are subject to IRS and other tax enforcement agencies' close monitoring and continuous audit. Both federal and states challenge taxpayers more aggressively due to their revenue demands. The tax reporting requirements (e.g. FAS109/ASC 740) increase the level of tax transparency and expose public companies to greater tax risks. Consequently, firms may have

limited flexibility to manage tax expenses downward. Furthermore, firms in monopoly industries may be in better positions to avoid taxes due to their monetary power. Monopolists could use their "deep" pockets to lobby for favorable tax breaks and hire top tax advisors to implement sophisticated tax strategies. Whether intense product market competition is associated with greater tax efficiency is ultimately an empirical question.

A growing stream of research seeks to explain why firms engage in different level of tax planning and exhibit different level of tax avoidance. Early studies focus on how factors associated with tax planning opportunities and resources affect corporate tax management (e.g. Zimmerman, 1983; Gupta and Newberry, 1997; Mills *et al.*, 1998; Rego, 2003). Recent studies extend this line of research by examining how executives affect firm-level tax behavior. Dyreng *et al.* (2010) documented a phenomenal executive effect on tax avoidance: moving between the top and the bottom quantiles of executives results in approximately 11 percent swing in GAAP effective tax rate. Law and Mills (2017) found that managers with military experience pursue less tax avoidance. Another extension by Robinson *et al.* (2010) investigates the effect of organizational form on the performance of corporate tax management. They found that evaluating tax departments as profit centers as opposed to cost centers leads to lower effective tax rates.

In contrast to the literature, we examine how competitive pressures from product markets motivate managers to engage in effective tax planning and improve firm performance. Our paper complements the literature by explicitly investigating how industry structure, industry product market competition in particular, influences corporate tax planning.

3. Research method

Measures of competition and efficiency of tax management

We employ the Herfindahl–Hirschman Index (*HHI*) as the main measure of competition. *HHI* is well-grounded in industry organization theory (Tirole, 1988) and widely used as a measure of competition in the accounting and finance literature (e.g. Harris, 1998; DeFond and Park, 1999; Hou and Robinson, 2006; Robinson *et al.*, 2010)[5]. A higher *HHI* value indicates weaker competition. *HHI* is defined as the sum of squared market shares of all the firms in each industry:

$$HHI_{j,t} = \sum_{i=1}^{n} S_{ijt}^2, \tag{1}$$

where S_{ijt} is the market share of firm i in industry j in year t. Market share is computed based on sales. Industry j is defined based on two-digit SIC codes[6]. We also consider *HHI*s based on three-digit SIC codes and other alternative versions of *HHI*s as robustness checks[7].

We also employ four-firm concentration ratio (*4FIRMRATIO*) to measure the extent of product market competition (e.g. Harris, 1998). Four-firm concentration ratio is measured using the market shares of the largest four firms in each industry:

$$4FIRMRATIO_{j,t} = \sum_{i=1}^{4} S_{ijt}^2. \tag{2}$$

We use both cash effective tax rate (*CETR*) and GAAP effective tax rate (*ETR*) to measure the efficiency of corporate tax management. *CETR* is defined as income tax paid per dollar pre-tax income. The recent literature suggests that cash effective tax rate overcomes several major limitations associated with traditional effective tax rate (e.g. Dyreng *et al.*, 2008). First, while traditional GAAP effective tax rate excludes potential tax savings resulting from tax strategies that create temporary book-tax differences (e.g. accelerating expense deduction and delaying revenue recognition), cash effective tax rate reflects tax savings from tax planning strategies that create both temporary and permanent book-tax

differences. Second, GAAP effective tax rate includes tax contingencies ("cushion") associated with uncertain tax positions taken on tax returns and may understate a firm's tax aggressiveness. In contrast, tax reserves have no impact on cash effective tax rate, which more accurately reflects the extent of a firm's tax avoidance on the tax-return basis.

Nonetheless, we also adopt GAAP effective tax rate as an additional measure of efficiency of tax management. *ETR*, which is defined as total income tax expense per dollar of pre-tax income, is widely used in prior literature to reflect effectiveness of tax planning (e.g. Mills *et al.*, 1998; Phillips, 2003; Robinson *et al.*, 2010). Note that *ETR* is affected by tax strategies to lower tax payments as well as strategies motivated to increase after-tax earnings (e.g. Dhaliwal *et al.*, 2004; Krull, 2004; Robinson *et al.*, 2010). Thus, results must be interpreted with caution when *ETR* is used as a proxy for the efficiency of tax management.

Cash effective tax rate and GAAP effective tax rate are measured both on an annual basis (*ETR* and *CETR*) and a long-run basis (*LETR* and *LCETR*). Consistent with prior research (e.g. Gupta and Newberry, 1997, Chen *et al.*, 2010), we constrain these effective tax rate measures to lie between 0 and 1 to prevent estimation problems and unreasonable values due to small denominators.

Sample selection

Panel A of Table I summarizes the sample selection procedures. The sample starts with 114,506 firm-years with valid SIC code from COMPUSTAT over the sample period of 1994–2008.

Panel A: sample selection procedures

Number of firm-years with valid SIC code from COMPUSTAT, 1994–2008	114,506
Less	
Firms in agricultural and forestry business (SIC: 0100-0900) and non-classifiable establishment (SIC: 9900)	(1,837)
Firm-years with missing annual effective tax rate data	(52,092)
Firm-years with missing industry concentration measures	(2,958)
Firm-years with missing control variables	(2,874)
Number of firm-years available for the main analysis[a]	54,745

Panel B: distribution of firms by year

Fiscal year	Number of firms	Number of firms in high-competition industries	Percentage of firms in high-competition industries
1994	4,265	1,768	41.5
1995	4,231	1,976	46.7
1996	4,588	1,900	41.4
1997	4,449	1,929	43.4
1998	3,947	1,919	48.6
	Sub-sample average	1,898	44.3
1999	3,702	1,571	42.4
2000	3,392	1,695	50.0
2001	2,866	1,514	52.8
2002	3,046	1,785	58.6
2003	3,160	1,994	63.1
	Sub-sample average	1,712	53.4
2004	3,483	2,272	65.2
2005	3,858	2,060	53.4
2006	3,752	1,972	52.6
2007	3,384	1,818	53.7
2008	2,622	1,446	55.1
	Sub-sample average	1,914	56.0

Note: [a]Number of firms in the sample: 9,844

Table I.
Sample distribution

Our sample starts from 1994 mainly because the implementation of SFAS 109 changes the way that deferred tax assets is recorded for financial reporting purposes. Our sample ends in year 2008 mainly because the severe economic recession in 2009 distorts the reporting and collection of corporate income taxes (Gupta *et al.*, 2014). A large number of firms generated significant amounts of *NOL*s on their tax returns. The US federal tax laws and state tax laws in many state jurisdictions allow 20 years of *NOL* carryforwards to offset future taxable income. For firms with large *NOL*s, lower effective tax rates reflect the simple application of *NOL* tax rules rather than the employment of sophisticated tax strategies to lower corporate tax burdens. We delete firms in agricultural and forestry business (SIC 0100-0900) and non-classifiable establishment (SIC 9900) (1,837 firm-years), because we are primarily interested in tax behavior of industrial and business service firms. We further delete 52,092 firm-years with missing annual effective tax rate (*ETR* and *CETR*) data. To be consistent with prior *ETR* studies, we deleted firms with negative pre-tax income (e.g. Zimmerman, 1983; Shevlin and Porter, 1992; Gupta and Newberry, 1997; Rego, 2003). Loss firms have different tax planning incentives. Moreover, it is difficult to interpret *ETR*s with negative components. We delete 2,958 firm-years with missing industry concentration measures (*HHI* and *4FIRMRATIO*). Finally, we delete 2,874 firm-years with missing control variables that are required in testing our main hypothesis. Our main sample includes 54,745 firm-years and 9,844 unique firms[8].

Panel B of Table I presents the distribution of sample firms by year. Panel B also shows the yearly distribution of firms in high-competition industries. High-competition industries are identified as follows: we rank industries based on the *HHI* value each year, and industries in the lowest *HHI* quartile are classified as high-competition industries. Panel B reveals that the percentage of firms in the high-competition industries has increased over time: in the first sub-sample period (1994–1998), 44.3 percent of sample firms are in the high-competition industries; in the second sub-sample period (1999–2003), the percentage is around 53.4 percent on average; and in the final sub-sample period (2004–2008), 56.0 percent of sample firms are in the high-competition industries. Thus, panel B reveals that more firms operate in an increasingly competitive environment over time.

Research design

We employ the following regression model to examine the effect of competition on the efficiency of tax management:

$$\begin{aligned} TAXVAR_{i,t} = {} & \beta_0 + \beta_1 COMPETITION_{j,t-1} + \beta_2 ROA_{i,t} + \beta_3 LEV_{i,t} \\ & + \beta_4 FI_{i,t} + \beta_5 ASSETS_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 RD_{i,t} \\ & + \beta_8 PPE_{i,t} + \beta_9 NOL_{i,t-1} + YEAR + SECTOR + \varepsilon, \end{aligned} \tag{3}$$

where i indexes firm, j indexes industry where firm i operates, t indexes year, the dependent variable *TAXVAR* is the measure of efficiency of tax management: cash effective tax rate (*CETR*), and GAAP effective tax rate (*ETR*). *COMPETITION* is the measure of industry competition: the *HHI*, an indicator variable taking the value of 1 for industries in the bottom *HHI* quartile and 0 otherwise (*D_LOWHHI*), four-firm concentration ratio (*4FIRMRATIO*), an indicator variable taking the value of 1 for industries in the bottom *4FIRMRATIO* quartile and 0 otherwise (*D_LOW4FIRMRATIO*). The control variables included in the model are: return on assets ($ROA_{i,t}$), leverage ($LEV_{i,t}$), the extent of foreign operation ($FI_{i,t}$), the natural logarithm of total assets ($ASSETS_{i,t}$), sales growth ($GROWTH_{i,t}$), intangible intensity ($RD_{i,t}$), capital intensity ($PPE_{i,t}$) and the presence of *NOL* carryforward at the beginning of the year ($NOL_{i,t-1}$). See Table AI for variable measurement.

The primarily variable of interest is *COMPETITON*. Consistent with the prediction that firms operating in competitive industries exhibit greater tax efficiency, we would expect β_1 to be positive (negative) if *COMETITION* is measured by *HHI* or *4FIRMRATIO* (*D_LOWHHI* or *D_LOW4FIRMRATIO*).

We control for firm characteristics that are documented in prior literature to represent the presence of tax planning opportunities. The rationale for including these variables in the regression model is that the extent of tax planning is limited by a firm's opportunities to take actions to either decrease taxable income or increase tax credits (e.g. Phillips, 2003). Following prior literature, we include leverage (*LEV*), foreign operations (*FI*), capital intensity (*PPE*) and intangible intensity (*RD*) in Equation (3) to control for a firm's tax planning opportunities. Prior research shows mixed results on the relation between leverage and measures of tax avoidance, thus we do not predict a sign on *LEV* (e.g. Gupta and Newberry, 1997; Chen *et al.*, 2010). As firms may choose to locate significant operations in low-tax foreign jurisdictions, we predict a negative coefficient on *FI* (e.g. Chen *et al.*, 2010)[9]. Consistent with prior studies, we expect a negative coefficient on *PPE* (e.g. Gupta and Newberry, 1997; Chen *et al.*, 2010)[10]. We include *RD* in the regression model but do not predict a sign on this variable for two reasons: first, the extent of intangible intensity may affect a firm's opportunities to shift income; second, the book and tax treatment for intangible assets may differ (e.g. Grubert and Slemrod, 1998; Chen *et al.*, 2010).

The second set of control variables that we include in the regression model are profitability (*ROA*), growth (*GROWTH*), firm size (*ASSETS*) and the presence of *NOL*s. Prior research yields mixed results on the relation between profitability and attributes of tax avoidance, thus we do not predict a sign on *ROA* (Gupta and Newberry, 1997; Chen *et al.*, 2010)[11]. Prior research suggests that growth firms may place less emphasis on tax planning, and thus we expect a positive coefficient on *GROWTH* (Chen *et al.*, 2010; Robinson *et al.*, 2010). We do not predict the sign on *ASSETS* because prior research yields mixed results on this variable. For example, as a proxy for political cost, *ASSETS* would bear a positive relation to *ETR*s (e.g. Zimmerman, 1983); as a proxy for tax sophistication, *ASSETS* should be negatively related to *ETR*s (e.g. Chen *et al.*, 2010). We predict a negative coefficient on *NOL* because firms can utilize *NOL* carryforward from prior years to lower their current year's tax burden.

To be consistent with prior research (e.g. Robinson *et al.*, 2010), we include year and sector (one-digit SIC code) dummies in the regression model[12]. We estimate Equation (3) using ordinary least squares (OLS). We adjust the standard errors for heteroskedasticity and time-series correlation by using robust standard errors clustered at the firm level (Petersen, 2009)[13].

Panel A of Table II presents summary statistics of variables used in the main analysis partitioned by competition. We classify those firms whose *HHI* values are in the bottom quartile of the *HHI* distribution into the "high competition" group, and the remaining firms into "low competition" group. The mean and median effective tax rates for low-competition firms (*ETR* mean = 0.327, *ETR* median = 0.361, *CETR* mean = 0.284 and *CETR* median = 0.271) are higher than the mean and median for high-competition firms (mean = 0.311, median = 0.350, *CETR* mean = 0.256, *CETR* median = 0.229). The mean profitability (*ROA*) for high-competition firms (0.124) is not significantly different from the mean for low-competition firms (0.126), but the median for high-competition firms (0.086) is slightly lower than the median for low-competition firms (0.089). Compared to their low-competition counterparts, high-competition firms are slightly larger and experience slightly slower growth; high-competition firms also exhibit lower level of financial leverage, higher level of intangible intensity, lower level of capital intensity and greater degree of foreign operations. These descriptive results indicate that competitive pressures are likely to affect effective tax rates. However, it is important to include other firm characteristics as controls to ensure that the difference in effective tax rates is not driven by firm fundamentals.

Panel A: descriptive statistics of variables in main analysis

Variable		Low competition ($n = 27{,}126$) Mean	Median	High competition ($n = 27{,}619$) Mean	Median
ETR	a, b	0.327	0.361	0.311	0.350
CETR	a, b	0.284	0.271	0.256	0.229
HHI	a, b	0.105	0.083	0.036	0.037
4FIRMRATIO	a, b	0.518	0.486	0.283	0.307
ROA	b	0.124	0.089	0.126	0.086
LEV	a, b	0.246	0.204	0.220	0.189
FI	a, b	0.008	0.000	0.012	0.000
ASSETS	a, b	5.828	5.796	5.914	5.913
GROWTH	a, b	0.212	0.121	0.205	0.112
RD	a, b	0.021	0.000	0.034	0.000
PPE	a, b	0.332	0.249	0.310	0.209
NOL	a, b	0.200	0.000	0.235	0.000

Panel B: correlation matrix (Pearson correlations are above the diagonal and Spearman correlations are below)

	1	2	3	4	5	6	7	8	9	10
1. *HHI*		*0.918*	−0.002	*−0.028*	*0.045*	*0.018*	*−0.009*	*−0.124*	*0.086*	*0.016*
2. *4FIRMRATIO*	*0.978*		0.008	0.000	*0.015*	*−0.008*	*−0.012*	*−0.104*	*−0.016*	*0.038*
3. *ROA*	*0.012*	−0.005		*0.118*	*−0.257*	*−0.231*	*0.311*	*0.244*	*0.012*	*−0.013*
4. *FI*	*0.016*	*0.025*	*0.105*		*−0.079*	*0.163*	*0.009*	*0.151*	*−0.039*	*0.107*
5. *LEV*	*0.026*	*0.013*	*−0.313*	*−0.024*		*0.226*	*−0.020*	*−0.258*	*0.251*	*0.012*
6. *ASSETS*	*−0.020*	*−0.014*	*−0.202*	*0.231*	*0.287*		*−0.109*	*−0.202*	*0.111*	*−0.048*
7. *GROWTH*	*0.010*	0.002	*0.303*	*−0.023*	*−0.061*	*−0.099*		*0.146*	*0.118*	0.006
8. *RD*	*−0.081*	*−0.059*	*0.204*	*0.277*	*−0.278*	*−0.157*	*0.065*		*−0.176*	*0.098*
9. *PPE*	*0.017*	*−0.014*	*0.108*	−0.007	*0.298*	*0.095*	*0.015*	*−0.118*		*−0.062*
10. *NOL*	*0.030*	*0.028*	−0.006	*0.123*	0.006	*−0.038*	0.002	*0.141*	*−0.046*	

Notes: Panel A presents descriptive statistics for variables used in the main analysis and Panel B provides Pearson and Spearman correlations among key variables. *ETR* is GAAP effective tax rate. *CETR* is cash effective tax rate. *HHI* is the Herfindahl–Hirschman Index. *4FIRMRATIO* is four-firm concentration ratio. *ROA* is return on assets. *LEV* is leverage. *FI* is foreign income. *ASSETS* is the natural logarithm of total assets. *GROWTH* is annual sales growth. *RD* is intangible intensity. *PPE* is capital intensity. *NOL* is a dummy variable with the value of 1 for the presence of net operating loss carryforward and 0 otherwise. All continuous variables are winsorized at 1 and 99 percent. All variables are defined in Table AI. [a]Indicates the difference in the means between low-competition firms and high-competition firms is significant at $p < 0.10$ using a two-tailed t test; [b]indicates the difference in the medians between low-competition firms and high-competition firms is significant at $p < 0.10$ using a two-tailed median test. Italic indicates the correlation is significant at $p < 0.05$

Table II.
Descriptive statistics

Panel B of Table II presents the correlations among explanatory variables. The two competition measures, *HHI* and *4FIRMRATIO*, are highly correlated (0.918, $p < 0.01$). Correlations among other explanatory variables are small, thereby mitigating possible multicollinearity concerns.

4. Results

Main result

Table III presents the results of tests on the relationship between industry competition and the efficiency of tax management. The dependent variable, efficiency of tax management, is measured by annual GAAP *ETR* (*ETR*) in Panel A, and annual cash *ETR* (*CETR*) in Panel B, respectively. Because the results for *ETR* and *CETR* are largely consistent, our discussion focuses on *CETR* results (Panel B). In Model 1, industry competition, the primarily variable of interest, is measured by the *HHI*. Consistent with our prediction, the estimated coefficient on

Panel A: efficiency of tax management = ETR

	Dependent variable = *ETR*			
	(1)	(2)	(3)	(4)
HHI	*0.109* (4.88)			
D_LOWHHI		*−0.018* (−7.94)		
4FIRMRATIO			*0.056* (6.67)	
D_LOW4FIRMRATIO				*−0.018* (−7.22)
ROA	−0.028 (−2.86)	−0.029 (−2.92)	−0.029 (−2.99)	−0.028 (−2.90)
LEV	−0.429 (−6.27)	−0.045 (−6.53)	−0.044 (−6.39)	−0.045 (−6.52)
FI	−0.134 (−2.95)	−0.125 (−2.76)	−0.132 (−2.91)	−0.124 (−2.74)
ASSETS	0.015 (20.94)	0.015 (20.96)	0.015 (20.97)	0.015 (21.00)
GROWTH	0.011 (3.63)	0.011 (3.71)	0.011 (3.70)	0.011 (3.75)
RD	−0.275 (−12.78)	−0.276 (−12.91)	−0.269 (−12.47)	−0.277 (−12.91)
PPE	−0.019 (−3.86)	−0.020 (−3.99)	−0.020 (−3.97)	−0.021 (−4.13)
NOL	−0.031 (−11.61)	−0.031 (−11.37)	−0.032 (−11.65)	−0.031 (−11.35)
Intercept	0.243 (27.81)	0.259 (30.53)	0.227 (24.47)	0.259 (30.53)
Year and Sector	Yes	Yes	Yes	Yes
R^2	0.071	0.072	0.072	0.072

Panel B: efficiency of tax management = CETR

	Dependent variable = *CETR*			
	(1)	(2)	(3)	(4)
HHI	*0.108* (4.23)			
D_LOWHHI		*−0.024* (−8.76)		
4FIRMRATIO			*0.054* (5.53)	
D_LOW4FIRMRATIO				*−0.020* (−6.81)
ROA	−0.177 (−15.89)	−0.178 (−16.05)	−0.178 (−16.01)	−0.178 (−15.97)
LEV	−0.089 (−11.02)	−0.091 (−11.34)	−0.089 (−11.09)	−0.091 (−11.27)
FI	−0.029 (−0.54)	−0.015 (−0.28)	−0.028 (−0.51)	−0.017 (−0.32)
ASSETS	0.011 (13.03)	0.010 (13.01)	0.011 (13.01)	0.011 (13.06)
GROWTH	−0.024 (−7.18)	−0.024 (−7.08)	−0.023 (−7.13)	−0.024 (−7.06)
RD	−0.213 (−8.77)	−0.210 (−8.71)	−0.207 (−8.53)	−0.213 (−8.81)
PPE	−0.056 (−9.28)	−0.058 (−9.59)	−0.056 (−9.37)	−0.058 (−9.61)
NOL	−0.058 (−18.24)	−0.058 (−17.99)	−0.059 (−18.27)	−0.058 (−17.99)
Intercept	0.252 (23.83)	0.270 (26.40)	0.237 (21.07)	0.269 (26.26)
Year and Sector	Yes	Yes	Yes	Yes
R^2	0.066	0.068	0.067	0.067

Notes: In Panel A, the dependent variable is GAAP effective tax rate (*ETR*). In Panel B, the dependent variable is cash effective tax rate (*CETR*). *HHI* is the Herfindahl–Hirschman Index. *D_LOWHHI* is a dummy variable with the value of 1 if *HHI* value is in the bottom quartile and 0 otherwise. *4FIRMRATIO* is four-firm concentration ratio. *D_LOW4FIRMRATIO* is a dummy variable with the value of 1 if *4FIRMRATIO* is in the bottom quartile and 0 otherwise. *ROA* is return on assets. *LEV* is leverage. *FI* is foreign income. *ASSETS* is the natural logarithm of total assets. *GROWTH* is annual sales growth. *RD* is intangible intensity. *PPE* is capital intensity. *NOL* is a dummy variable with the value of 1 for the presence of net operating loss carryforward and 0 otherwise. All continuous variables are winsorized at 1 and 99 percent. All variables are defined in Table AI. The sample consists of 54,745 firm-year observations. The regressions are pooled regressions with year and industry (one-digit SIC code) controls. *t*-Statistic appears in parentheses below coefficient estimates. Robust standard errors are clustered at the firm level

Table III.
Regressions of firm-level tax avoidance on industry competition

HHI is positive and statistically significant ($p < 0.01$). The positive coefficient on *HHI* (0.108) is consistent with the view that firms in competitive industries are associated with lower cash effective tax rates even after controlling for other factors related to the extent of tax avoidance.

The coefficients on the control variables are generally in line with the literature. For example, the coefficients for tax planning opportunities variables (*LEV, FI*, *RD* and *PPE*) are negative and statistically significant, suggesting that increased tax planning opportunities lower firms' *CETR*. As expected, the coefficient on *NOL* is negative and significant.

The coefficient on *ROA* is negative and statistically significant, consistent with the notion that more profitable firms have more incentives and resources to engage in sophisticated tax planning and thus avoid more taxes. The coefficient on *ASSETS* is positive and statistically significant. Inconsistent with the view that growth firms place less emphasis on tax planning, the coefficient on *GROWTH* is negative and significant[14].

In Model 2, we use an indicator variable *D_LOWHHI* to measure competition. *D_LOWHHI* takes the value of 1 if a firm's HHI value falls in the bottom quartile. The estimation results in Model 2 are consistent with the results in Model 1. The negative coefficient on *D_LOWHHI* (−0.024) is statistically significant ($p < 0.01$), suggesting that conditional on the remaining independent variables, firms operating in a more competitive environment are associated with a reduction in cash effective tax rate of 2.4 percent. Models 3 and 4, where competition is measured by four-firm concentration ratio (*4FIRMRATIO*) or the dummy variable for low four-firm concentration ratio (*D_LOW4FIRMRATIO*), yield similar results.

Change analysis

The positive correlation between *HHI* or *4FIRMRATIO* and effective tax rates is consistent with the view that in a competitive environment, managers are under constant pressures to reduce tax expenses through effective tax planning. To further substantiate this argument, we perform the following change analysis:

$$\Delta TAXVAR = \beta_0 + \beta_1 \Delta COMPETITION + \beta_2 \Delta ROA + \beta_3 \Delta LEV + \beta_4 \Delta FI + \beta_5 \Delta ASSETS + \beta_6 \Delta GROWTH + \beta_7 \Delta RD + \beta_8 \Delta PPE + \beta_9 \Delta NOL + \varepsilon. \quad (4)$$

Since the structure of product markets and the structure of corporate tax management are both fixed over a short horizon, we use all firms that exist in both the first sub-sample period (1994–1998) and the third sub-sample period (2004–2008) to conduct a change analysis – the effect of changes in industry competition on changes in effective tax rates. Specifically, for each firm, we calculate the average values of the dependent variables (*ETR* and *CETR*) and the average values of the explanatory variables for the first and the third sub-sample periods. The change variables are measured by the differences in these two sub-sample means[15].

Results of the change analysis are reported in Table IV. Model 1, where the dependent variable is *ΔETR*, shows that the coefficient on *ΔHHI* is statistically insignificant (−0.02, $p = 0.775$); Model 2, where the dependent variable is *ΔCETR*, reveals that the coefficient on *ΔHHI* is positive and statistically significant (0.318, $p < 0.01$). Thus, *CETR* change analysis indicates that reduced competition leads to higher cash effective tax rate. These results suggest that firms pursue efficient tax planning strategies to reduce cash tax payments when faced with increased competition pressures from product markets. They seem to put less emphasis on managing after-tax earnings performance. Thus, change analysis also provides some support for our argument that intense product market competition motivates managers to reduce tax payments through effective tax planning.

5. Additional analysis

The role of cash flow volatility and industry investment opportunities

In this section, we explore some cross-sectional variations in the relationship between industry competition and the efficiency of tax management. First, we examine the role of cash flow volatility in modifying the effect of competition on tax efficiency. Prior research suggests that competition tends to increase profit volatility and reduce the level of pre-tax profitability (Raith, 2003). This suggests that competition may constrain a firm's ability to engage in effective tax planning in two ways: first, increased profit volatility makes it difficult for firms in high-competition industries to accurately forecast future operating cash flows. Effective tax

	Dependent variable = ΔETR (1)	Dependent variable = $\Delta CETR$ (2)
ΔHHI	*−0.020* (−0.29)	*0.318* (3.78)
ΔROA	−0.041 (−1.28)	−0.064 (−1.96)
ΔLEV	0.020 (0.89)	−0.004 (−0.15)
ΔFI	0.368 (2.26)	−0.352 (−1.97)
$\Delta ASSETS$	−0.034 (−8.05)	0.036 (7.47)
$\Delta GROWTH$	−0.002 (−0.20)	0.013 (0.87)
ΔRD	−0.128 (−1.04)	0.317 (2.65)
ΔPPE	−0.064 (−2.67)	−0.013 (−0.46)
ΔNOL	0.040 (5.04)	−0.056 (−5.81)
Intercept	0.037 (6.54)	−0.047 (−6.77)
R^2	0.052	0.048

Notes: The table reports regressions of change in effective tax rates from the first sub-sample period (1994–1998) to the last sub-sample period (2004–2008). In Column (1), the dependent variable is change in GAAP effective tax rate (ΔETR). In Column (2), the dependent variable is change in cash effective tax rate ($\Delta CETR$). ΔHHI is the change in Herfindahl–Hirschman Index. ΔROA is change in return on assets. ΔLEV is change in leverage. ΔFI is change in foreign income. $\Delta ASSETS$ is change in the natural logarithm of total assets. $\Delta GROWTH$ is change in sales growth. ΔRD is change in intangible intensity. ΔPPE is change in capital intensity. ΔNOL is change in net operating loss carryforward. All continuous variables are winsorized at 1 and 99 percent. All variables are defined in Table AI. The sample consists of 2,756 firm-year observations. *t*-Statistic appears in parentheses below coefficient estimates. Robust standard errors are used to adjust for heteroskedasticity

Table IV.
Regression of tax avoidance on industry competition: change analysis

planning, however, requires an accurate forecast of future taxable income (a.k.a. future cash flows). Second, increased cash flow volatility may reduce firms' willingness to pay significant out-of-pocket costs for tax planning activities (e.g. Mills *et al.*, 1998)[16]. Minton and Schrand (1999) documented that higher cash flow volatility is associated with lower discretional investment in capital expenditures, research and development costs, and advertising expenses. Tax departments may face similar budget constraints to carry out all tax minimization projects. Taken together, this suggests that firms in high-competition industries but with relatively less volatile operating cash flows are in a better position to efficiently manage taxes. Thus, we expect the effect of competition on effective tax planning to be stronger for firms with low cash flow volatility.

Second, we examine the moderating effect of industry investment opportunities on the relation between competition and tax management. We expect that the correlation between competition and efficiency of tax management to be stronger for firms in industries with low investment opportunities. In industries with ample investment opportunities, firms may have greater ability to maintain profitability by investing in new projects and thus place less emphasis on cost reduction. In contrast, firms with few industry investment opportunities may focus on improvement in efficiency to gain a competitive edge.

To examine the moderating effect of cash flow volatility, we augment Equation (3) by interacting the competition measure (*D_LOWHHI*) with the cash flow volatility measure (*D_LOWsdCF)*:

$$\begin{aligned} TAXVAR_{i,t} = {} & \beta_0 + \beta_1 D\_LOWHHI_{j,t-1} + \beta_2 D\_LOWsdCF_{i,t} \\ & + \beta_3 D\_LOWHHI_{j,t-1} \times D\_LOWsdCF_{i,t} \\ & + \beta_4 ROA_{i,t} + \beta_5 LEV_{i,t} + \beta_6 FI_{i,t} + \beta_7 ASSETS_{i,t} \\ & + \beta_8 GROWTH_{i,t} + \beta_9 RD_{i,t} + \beta_{10} PPE_{i,t} \\ & + \beta_{11} NOL_{i,t-1} + YEAR + SECTOR + \varepsilon. \end{aligned} \quad (5a)$$

To examine the moderating effect of industry investment opportunities, we augment Equation (3) by interacting the competition measure (*D_LOWHHI*) with a measure for industry investment opportunities (*D_LOWINDINVEST)*:

$$\begin{aligned} TAXVAR_{i,t} = {} & \beta_0 + \beta_1 D\_LOWHHI_{j,t-1} + \beta_2 D\_LOWINDINVEST_{j,t-1} \\ & + \beta_3 D\_LOWHHI_{j,t-1} \times D\_LOWINDINVEST_{j,t-1} + \beta_4 ROA_{i,t} \\ & + \beta_5 LEV_{i,t} + \beta_6 FI_{i,t} + \beta_7 ASSETS_{i,t} + \beta_8 GROWTH_{i,t} + \beta_9 RD_{i,t} \\ & + \beta_{10} PPE_{i,t} + \beta_{11} NOL_{i,t-1} + YEAR + SECTOR + \varepsilon. \end{aligned} \quad (5b)$$

The main variables of interest are the interaction terms between the high-competition dummy (*D_LOWHHI*) and a dummy variable indicating low cash flow volatility (*D_LOWsdCFO*) or fewer industry investment opportunities (*D_LOWINDINVEST*). Following prior research, we use standard deviation of operating cash flows (*sdCFO*) to measure cash flow volatility and market-to-book ratio (*MB*) to measure investment opportunities (e.g. Minton and Schrand, 1999; Smith and Watts, 1992; Haushalter *et al.*, 2007). *D_LOWsdCFO* takes the value of 1 if a firm's cash flow volatility is below the sample median in a particular year.

D_LOWINDINVEST takes the value of 1 if an industry's market-to-book ratio is below the 25th percentile. Consistent with our prediction that the effect of competition on tax avoidance is more pronounced for firms with low cash flow volatility and for firms with fewer industry investment opportunities, we expect the coefficients on the interaction terms (β_3) to be negative.

Table V reports the estimation result of Equations (5a) and (5b). We find that the coefficients on these interaction terms are negative and significant across all four columns[17]. For example, in Model 2, the coefficient on *D_LOWHHI* is negative and significant (−0.017, $p < 0.01$), and the coefficient on *D_LOWHHI* × *D_LOWsdCF* is also negative and statistically significant (−0.013, $p < 0.01$). This suggests that high competition has differential *CETR* consequence for firms with low cash flow volatility vs firms with high cash flow volatility.

Specifically, *CETR* is 1.7 percent lower for high-competition firms with high cash flow volatility; *CETR* is 3 percent lower for high-competition firms with low cash flow volatility. Turing to the moderating role of industry investment opportunities, Model 4 shows that *CETR* is 1.7 percent lower for high-competition firms with more industry investment opportunities; *CETR* is 5 percent lower for high-competition firms with fewer industry investment opportunities. These results confirmed our prediction that the relationship between competition and the efficiency of tax management is stronger for firms with low cash flow volatility and fewer industry investment opportunities.

The effect of changes in regulatory and enforcement environments

We further explore whether changes in regulatory and enforcement environments modify the relation between industry competition and the efficiency of tax management. With the passage of new legislation and the implementation of new regulations, firms face a different regulatory and enforcement environment in the last part of our sample period (2003–2008). The journey to improve tax governance and transparency is shaped by the following efforts and major mile stones: the Sarbanes-Oxley Act of 2002 (SOX), new schedule M-3 for book-to-tax differences, and FASB Interpretation No. 48: Accounting for Uncertainty in Income Taxes[18][19][20].

New regulatory environments may change the costs and benefits of tax management. For many firms, the emphasis of their tax departments may shift from tax planning, especially aggressive tax planning, to tax compliance and tax risk management. Here, we

	Dependent variable = *ETR* (1)	Dependent variable = *CETR* (2)	Dependent variable = *ETR* (3)	Dependent variable = *CETR* (4)
D_LOWHHI	−0.014 (−4.20)	−0.017 (−4.14)	−0.012 (−5.19)	−0.017 (−5.76)
D_LOWsdCFO	0.013 (4.87)	0.019 (5.45)		
D_LOWHHI × *D_LOWsdCFO*	*−0.008* (−2.00)	*−0.013* (−2.66)		
D_LOWINDINVEST			−0.008 (−2.26)	0.008 (1.70)
D_LOWHHI × *D_LOWINDINVEST*			*−0.024* (−5.08)	*−0.033* (−5.33)
ROA	−0.027 (−2.77)	−0.176 (−15.86)	−0.031 (−3.17)	−0.178 (−16.07)
LEV	−0.045 (−6.62)	−0.091 (−11.45)	−0.046 (−6.78)	−0.092 (−11.52)
FI	−0.125 (−2.76)	−0.015 (−0.28)	−0.140 (−3.08)	−0.024 (−0.44)
ASSETS	0.014 (11.99)	0.010 (11.83)	0.015 (21.22)	0.010 (13.16)
GROWTH	0.010 (3.53)	−0.025 (−7.30)	0.010 (3.43)	−0.024 (−7.26)
RD	−0.277 (−12.96)	−0.211 (−8.78)	−0.285 (−13.33)	−0.215 (−8.90)
PPE	−0.022 (−4.42)	−0.061 (−10.08)	−0.019 (−3.84)	−0.057 (−9.40)
NOL	−0.030 (−11.01)	−0.056 (−17.57)	−0.031 (−11.43)	−0.057 (−17.87)
Intercept	0.257 (30.01)	0.266 (25.90)	0.260 (30.58)	0.268 (26.21)
Year and Sector	Yes	Yes	Yes	Yes
R^2	0.072	0.069	0.074	0.069

Notes: In Columns (1) and (3), the dependent variable is GAAP effective tax rate (*ETR*). In Columns (2) and (4), the dependent variable is cash effective tax rate (*CETR*). *D_LOWHHI* is a dummy variable with the value of 1 if the Herfindahl–Hirschman Index value is in the bottom quartile and 0 otherwise. *D_LOWsdCFO* is a dummy variable with the value of 1 if the standard deviation of cash flow is below the median and 0 otherwise. *D_LOWINDINVEST* is a dummy variable with the value of 1 if the industry market-to-book ratio is in the bottom quartile and 0 otherwise. *ROA* is return on assets. *LEV* is leverage. *FI* is foreign income. *ASSETS* is the natural logarithm of total assets. *GROWTH* is annual sales growth. *RD* is intangible intensity. *PPE* is capital intensity. *NOL* is a dummy variable with the value of 1 for the presence of net operating loss carryforward and 0 otherwise. All continuous variables are winsorized at 1 and 99 percent. All variables are defined in Table AI. The sample consists of 54,745 firm-year observations. The regressions are pooled regressions with year and industry (one-digit SIC code) controls. *t*-Statistic appears in parentheses below coefficient estimates. Robust standard errors are clustered at the firm level

Table V.
Variation in the relation between tax avoidance and industry competition

run a horse race between the regulatory forces and the economic forces (i.e. high-competition pressures), and examine how changes in these underlying forces alter corporate tax management behavior. To do this, we examine whether the relationship between product market competition and the extent of tax avoidance differs in the low-regulation regime (1994–2002) vs in the high-regulation regime (2003–2008).

To examine the impact of changes in regulatory and enforcement environments, we augment Equation (3) by interacting the competition measure (*D_LOWHHI*) with the high-regulation dummy variable (*D_HIGHREG*):

$$\begin{aligned} TAXVAR_{i,t} = {} & \beta_0 + \beta_1 D\_LOWHHI_{j,t-1} + \beta_2 D\_HIGHREG_t \\ & + \beta_3 D\_LOWHHI_{j,t-1} \times D\_HIGHREG_t + \beta_4 ROA_{i,t} + \beta_5 LEV_{i,t} \\ & + \beta_6 FI_{i,t} + \beta_7 ASSETS_{i,t} + \beta_8 GROWTH_{i,t} + \beta_9 RD_{i,t} + \beta_{10} PPE_{i,t} \\ & + \beta_{11} NOL_{i,t-1} + YEAR + INDUSTRY + \varepsilon. \end{aligned} \quad (6)$$

In Equation (6), *D_HIGHREG* is an indicator variable taking the value of 1 for firm-years in the high-regulation period (2003–2008) and 0 otherwise. The primary variable of interest is the interaction term (*D_LOWHHI* × *D_HIGHREG*) between high competition (*D_LOWHHI* and high regulation/enforcement (*D_HIGHREG*). If in high-regulation and high-enforcement environments, firms in competitive industries have weaker incentives to avoid taxes, then β_3 should be positive.

Table VI presents the estimation results. The estimated coefficients on the interaction terms are negative and statistically significant across both columns (e.g. $\beta_3 = -0.009$, $p < 0.05$ in *ETR* model; $\beta_3 = -0.031$, $p < 0.01$ in *CETR* model). These results suggest that competitive pressures arising from product markets play an increasingly important role in corporate tax management practices even in an environment characterized by increased regulation and increased enforcement. These results, however, are not completely surprising. If increased regulation and increased enforcement primarily aim to curb abusive tax sheltering rather than reduce the competitiveness of US business entities, they should have limited impact on efficient tax management through other effective tax planning strategies.

Industry competition and aggressive tax planning

In this section, we explore whether firms in high-competition industries use aggressive tax avoidance strategies to reduce their tax burdens. We employ the following regression model to estimate the effect of competition on aggressive tax avoidance:

$$SHELTER_{i,t} = \beta_0 + \beta_1 COMPETITION_{j,t-1} + \beta_2 ROA_{i,t} + \beta_3 LEV_{i,t} + \beta_4 FI_{i,t} + \beta_5 ASSETS_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 RD_{i,t} + \beta_8 PPE_{i,t} + \beta_9 NOL_{i,t-1} + YEAR + SECTOR + \varepsilon. \quad (7)$$

We use *SHELTER*, the estimated sheltering probability based on Wilson (2009) tax sheltering model to measure aggressive tax avoidance:

$$SHELTER = -4.86 + 5.20 \times BTD + 4.08 \times |DAP| - 1.41 \times LEV + 0.76 \times AT + 3.51 \times ROA + 1.72 \times FOREIG + 2.43 \times RD. \quad (8)$$

See Wilson (2009) for detailed variable definitions.

	Dependent variable = *ETR* (1)	Dependent Variable = *CETR* (2)
D_LOWHHI	−0.015 (−5.89)	−0.013 (−4.07)
D_HIGHREG	−0.016 (−3.70)	−0.054 (−9.34)
D_LOWHHI × D_HIGHREG	*−0.009* (−2.20)	*−0.031* (−6.28)
ROA	−0.029 (−2.91)	−0.178 (−16.01)
LEV	−0.044 (−6.52)	−0.091 (−11.30)
FI	−0.012 (−2.70)	−0.006 (−0.11)
ASSETS	0.015 (20.96)	0.010 (12.96)
GROWTH	0.011 (3.71)	−0.024 (−7.08)
RD	−0.274 (−12.81)	−0.203 (−8.43)
PPE	−0.020 (−3.97)	−0.057 (−9.53)
NOL	−0.031 (−11.32)	−0.057 (−17.81)
Intercept	0.259 (30.48)	0.268 (26.37)
Year and Sector	Yes	Yes
R^2	0.072	0.069

Notes: In Column (1), the dependent variable is GAAP effective tax rate (*ETR*). In Column (2), the dependent variable is cash effective tax rate (*CETR*). *D_LOWHHI* is a dummy variable with the value of 1 if the Herfindahl–Hirschman Index value is in the bottom quartile and 0 otherwise. *D_HIGHREG* is a dummy variable with the value of 1 for the high-regulation period (2003–2008) and 0 otherwise. *ROA* is return on assets. *LEV* is leverage. *FI* is foreign income. *ASSETS* is the natural logarithm of total assets. *GROWTH* is annual sales growth. *RD* is intangible intensity. *PPE* is capital intensity. *NOL* is a dummy variable with the value of 1 for the presence of net operating loss carryforward and 0 otherwise. All continuous variables are winsorized at 1 and 99 percent. All variables are defined in Table AI. The sample consists of 54,745 firm-year observations. The regressions are pooled regressions with year and sector controls. *t*-Statistic appears in parentheses below coefficient estimates. Robust standard errors are clustered at the firm level

Table VI. The effect of regulatory environment change on the relation between industry competition and tax avoidance

Table VII presents the results on the relationship between industry competition and aggressive tax avoidance. The significant negative coefficients (e.g. −0.011, $p < 0.01$) on the high-competition dummy (*D_LOWHHI*) in Model 1 suggest that although firms in competitive environments face severe downward cost pressures, they are in fact less likely to use aggressive tax avoidance strategies to reduce their tax burdens[21]. This result also partially explains why firms in competitive industries can maintain low effective tax rates in the high-regulation regime.

Product market competition and tax avoidance in the post-recession period

In the previous sections, we use sample firms from the period 1994–2008 to examine the association between product market competition and corporate tax avoidance. Due to the deep economic recession in 2008, a large number of firms suffer declines in revenues and report *NOL*s of large magnitude. Under the tax rules effective over the period 1994–2016, companies are allowed to carry over their *NOL*s to offset their future taxable income over the next 20 years. Thus, the lower effective tax rates in the post-recession period may reflect the application of *NOL* carryforward rather than the implementation of complex tax strategies. Nonetheless, we use the post-recession data (2009–2016) to test whether the most recent and severe economic recession alters the relation between product market competition and corporate tax efficiency.

Table VIII presents the estimation results. The estimated coefficients on the continuous competition measure (*HHI*) are positive and statistically significant (0.055, $p < 0.10$ and 0.167, $p < 0.01$) in both *ETR* and *CETR* specifications. The estimated coefficients on the high-competition indicator variable (*D_LowHHI*) are negative and statistically significant (−0.011, $p < 0.05$ and −0.026, $p < 0.01$) for both *ETR* and *CETR* specifications. The results (un-tabulated) are inferentially similar if we use *4FIRMRATIO* to measure the extent of product market competition.

	Dependent variable = *SHELTER* (1)	Dependent variable = *SHELTER* (2)
D_LOWHHI	−0.011 (−4.52)	−0.013 (−3.07)
ROA	0.323 (22.03)	
LEV	−0.162 (−22.67)	
FI	−0.181 (−3.30)	
ASSETS	0.085 (100.49)	
GROWTH	−0.012 (−2.95)	−0.015 (−3.19)
RD	−0.006 (−0.22)	
PPE	0.061 (11.34)	0.101 (10.37)
NOL	−0.018 (−5.60)	−0.036 (−6.93)
Intercept	0.190 (21.48)	0.608 (43.61)
Year and Sector	Yes	Yes
R^2	0.373	0.06

Notes: The dependent variable is the estimated sheltering probability (*SHELTER*) based on Wilson (2009) model. *D_LOWHHI* is a dummy variable with the value of 1 if the Herfindahl–Hirschman Index value is in the bottom quartile and 0 otherwise. *ROA* is return on assets. *LEV* is leverage. *FI* is foreign income. *ASSETS* is the natural logarithm of total assets. *GROWTH* is annual sales growth. *RD* is intangible intensity. *PPE* is capital intensity. *NOL* is a dummy variable with the value of 1 for the presence of net operating loss carryforward and 0 otherwise. All continuous variables are winsorized at 1 and 99 percent. All variables are defined in Table AI. The sample consists of 49,827 firm-year observations. The regressions are pooled regressions with year and sector (one-digit SIC code) controls. *t*-Statistic appears in parentheses below coefficient estimates. Robust standard errors are clustered at the firm level

Table VII.
Regression of aggressive tax avoidance on industry competition

	Efficiency of tax management = *ETR* or *CETR*			
	Dependent variable = *ETR*		Dependent variable = *CETR*	
	(1)	(2)	(3)	(4)
HHI	*0.055* (1.80)		*0.167* (4.78)	
D_LOWHHI		*−0.011* (−2.33)		*−0.026* (−4.88)
ROA	−0.135 (−7.62)	−0.136 (−7.64)	−0.059 (−5.46)	−0.224 (−11.39)
LEV	−0.046 (−4.62)	−0.047 (−4.70)	−0.058 (−5.46)	−0.060 (−5.62)
FI	−0.297 (−6.24)	−0.296 (−6.22)	−0.036 (−0.71)	−0.034 (−0.66)
ASSETS	0.002 (1.82)	0.002 (1.87)	0.006 (5.27)	0.006 (5.34)
GROWTH	−0.037 (−6.22)	−0.037 (−6.17)	−0.065 (−10.16)	−0.064 (−10.07)
RD	−0.398 (−9.22)	−0.389 (−8.92)	−0.362 (−7.84)	−0.348 (−7.48)
PPE	−0.411 (−4.89)	−0.043 (−5.10)	−0.129 (−13.29)	−0.133 (−13.65)
NOL	0.001 (0.33)	0.001 (0.34)	−0.012 (−2.75)	−0.011 (−2.67)
Intercept	0.344 (25.41)	0.259 (30.53)	0.227 (24.47)	0.324 (21.91)
Year and Sector	Yes	Yes	Yes	Yes
R^2	0.047	0.047	0.088	0.088

Notes: The dependent variable is GAAP effective tax rate (*ETR*) or cash effective tax rate (*CETR*). *HHI* is the Herfindahl–Hirschman Index. *D_LOWHHI* is a dummy variable with the value of 1 if *HHI* value is in the bottom quartile and 0 otherwise. *ROA* is return on assets. *LEV* is leverage. *FI* is foreign income. *ASSETS* is the natural logarithm of total assets. *GROWTH* is annual sales growth. *RD* is intangible intensity. *PPE* is capital intensity. *NOL* is a dummy variable with the value of 1 for the presence of net operating loss carryforward and 0 otherwise. All continuous variables are winsorized at 1 and 99 percent. All variables are defined in Table AI. The sample consists of 54,745 firm-year observations. The regressions are pooled regressions with year and sector (one-digit SIC code) controls. *t*-Statistic appears in parentheses below coefficient estimates. Robust standard errors are clustered at the firm level

Table VIII. Firm-level tax avoidance and industry competition in the post-recession period

The effect of comparability on corporate tax efficiency

In this section, we explore whether "comparability" affects the link between industry product market competition and corporate tax efficiency. "Comparability," which refers to the quality of information that enables users to identify similarities and differences between two sets of economic phenomena (FASB, 1980 P40), facilitates corporate tax planning by encouraging firms to implement tax strategies adopted by their industry peers. The inputs of corporate income tax returns are directly taken from financial statements. The lack of financial statement comparability may impede firms' ability to identity economic transactions and events similar or dissimilar to those experienced by their industry peers. Thus, it is difficult for corporate tax departments to engage in effective corporate tax planning suitable for their economic positions. Furthermore, the lack of financial statement comparability signals less incentives to adopt accounting functions (i.e. accounting information system) compatible with their industry peers. Likewise, such firms may have less incentives to implement effective tax planning strategies adopted by their industry peers.

Empirically, we use the comparability measure adopted by De Franco *et al.* (2011) and Zhang (2018) to gauge the extent of financial statement comparability. De Franco *et al.* (2011) defined accounting systems as a mapping from economic events to financial statements. They use earnings to proxy for financial statements and stock returns to proxy for economic events. They estimate firm-specific accounting functions for firm i and firm j based on the earnings and return relation. Accounting comparability between firm i and firm j is the negative value of the average absolute differences between the predicted earnings using firm i's and firm j's functions (See De Franco *et al.*, 2011, pp. 899-901). We use the following regression model to examine the

effect of accounting comparability on the link between product market competition and corporate tax efficiency:

$$TAXVAR_{i,t} = \beta_0 + \beta_1 D\_LOWHHI_{j,t-1} + \beta_2 D\_CompAcctInd_{i,t} + \beta_3 D\_LOWHHI_{j,t-1} \times D\_CompAcctInd_{i,t} + \beta_4 ROA_{i,t} + \beta_5 LEV_{i,t} + \beta_6 FI_{i,t} + \beta_7 ASSETS_{i,t} + \beta_8 GROWTH_{i,t} + \beta_9 RD_{i,t} + \beta_{10} PPE_{i,t} + \beta_{11} NOL_{i,t-1} + YEAR + SECTOR + \varepsilon, \quad (9)$$

where $CompAcctInd_{i,t}$ is the median accounting comparability for all firms j in the same industry as firm i during period t. The main variable of interest is the interaction term between the high-competition indicator variable (*D-LOWHHI*) and an indicator variable indicating low accounting comparability (*D_CompAcctInd*). *D_CompAcctInd* takes the value of 1 if a firm's comparability is below the 25th percentile in a particular year.

We use the intersection of firms that have both tax avoidance data and accounting comparability data over the period of 1994–2013[22]. Table IX presents the estimation results. The estimated coefficients on the interaction terms are positive and statistically significant across both columns (e.g. 0.020, $p < 0.01$ in *ETR* model; 0.033, $p < 0.01$ in *CETR* model). These results are consistent with our expectation that the lack of accounting comparability weakens the link between product market competition and corporate tax efficiency.

	Dependent variable = *ETR* (1)	Dependent variable = *CETR* (2)
D_LOWHHI	−0.019 (−6.26)	−0.032 (−8.64)
D_CompAcctInd	−0.065 (−9.06)	−0.059 (−7.46)
D_LOWHHI × *D_CompAcctInd*	*0.020* (2.53)	*0.033* (3.69)
ROA	0.022 (1.23)	−0.203 (−9.96)
LEV	−0.018 (−1.88)	−0.072 (−5.62)
FI	−0.348 (−7.33)	−0.041 (−0.72)
ASSETS	0.007 (7.56)	0.007 (6.15)
GROWTH	−0.001 (−0.30)	−0.048 (−7.79)
RD	−0.345 (−10.48)	−0.331 (−8.71)
PPE	−0.020 (−3.07)	−0.078 (−9.02)
NOL	−0.015 (−4.82)	−0.034 (−8.39)
Intercept	0.316 (26.92)	0.321 (21.91)
Year and Sector	Yes	Yes
R^2	0.076	0.075

Notes: In Column (1), the dependent variable is GAAP effective tax rate (*ETR*). In Column (2), the dependent variable is cash effective tax rate (*CETR*). *D_LOWHHI* is a dummy variable with the value of 1 if the Herfindahl–Hirschman Index value is in the bottom quartile and 0 otherwise. *D_CompAcctInd* is a dummy variable with the value of 1 if the accounting comparability measure is in the bottom quartile and 0 otherwise. *ROA* is return on assets. *LEV* is leverage. *FI* is foreign income. *ASSETS* is the natural logarithm of total assets. *GROWTH* is annual sales growth. *RD* is intangible intensity. *PPE* is capital intensity. *NOL* is a dummy variable with the value of 1 for the presence of net operating loss carryforward and 0 otherwise. All continuous variables are winsorized at 1 and 99 percent. All variables are defined in Table AI. The regressions are pooled regressions with year and industry (one-digit SIC code) controls. *t*-Statistic appears in parentheses below coefficient estimates. Robust standard errors are clustered at the firm level

Table IX.
Accounting comparability, industry competition and tax avoidance

6. Other robustness checks

Measure of competition

In the main analysis, we use the lagged value of the *HHI* and four-firm concentration ratio based on two-digit SIC codes to measure the extent of product market competition. We replicate the main analysis by using *HHI* and four-firm concentration ratio based on three-digit SIC codes. The results (un-tabulated) are similar to those reported in Table III.

Furthermore, prior studies also construct industry average *HHI* over the five years prior to the event year to remove potential year-to-year variations in *HHI* (e.g. DeFond and Park, 1999). We estimate the basic specification using average lagged value of the *HHI* and average lagged value of four-firm concentration ratio (up to five years). The main results (un-tabulated) are qualitatively similar to those reported in Table III.

Following prior research, sales for multi-industry firms are assigned to each firm's primary SIC code in calculating the *HHI* and four-firm concentration ratio. This estimation method, however, may lead to measurement errors if these firms operate in diverse industries. Thus, we also employ an alternative method to measure industry concentration:

$$HHI_{j,t} = \sum_{i=1}^{n} \left[s_{i,j,t} / S_{j,t} \right]^2, \tag{10}$$

$$4FIRMRATIO_{j,t} = \sum_{i=1}^{n} \left[s_{i,j,t} / S_{j,t} \right], \tag{11}$$

where $S_{i,j,t}$, firm i's sales in industry j in year t, equals firm i's segment sales if firm i is a multi-segment firm or equals firm i's total sales if firm i is a single-segment firm. $S_{j,t}$, industry j's sales in year t, is the sum of sales for all firms in industry j.

The main results (un-tabulated) are inferentially similar if we use the above alternative method to measure *HHI* and *4FIRMRATIO*.

Measure of long-run tax avoidance

We also adopt long-run *CETR* (*LCETR*) and long-run *ETR* (*LETR*) to measure the efficiency of tax management. Both annual *CETR* and annual *ETR* contain measurement errors caused by the mismatch between the numerator and the denominator. For example, the numerator of *CETR* is affected by tax refunds for prior years, settlements of government audits on prior-year tax returns and estimated tax payments for future years; the numerator of *ETR* is affected by changes in valuation allowance against deferred tax assets and changes in reserves for uncertain tax positions. Moreover, *LCETR* and *LETR* also reflect a firm's ability to avoid tax in the long run, which is arguably a more convincing measure of the efficiency of tax management[23]. *LCETR* is the ratio of the sum of cash tax payments over a five-year horizon divided by the sum of pre-tax income over the same five-year period[24]. *LETR* is the ratio of the sum of total tax expense over a five-year horizon divided by the sum of pre-tax income over the same five-year period (Dyreng *et al.*, 2008).

To examine the effect of industry competition on tax management in the long run, we average explanatory variables over a five-year window and test their relations with long-run GAAP *ETR* (*LETR*) and long-run cash *ETR* (*LCETR*). Table VIII reveals that long-run *HHI* (*LHHI*) bears a significant positive relation with both long-run measures of tax efficiency (*LETR* and *LCETR*), indicating that competition is associated with long-run tax efficiency. Results (un-tabulated) are qualitatively similar when industry competition is gauged by four-firm concentration ratio.

Are profits driving the results?

We find that firms in a more competitive environment exhibit lower effective tax rates. An alternative explanation for this inverse relation is that competition reduces profits and thus leads firms to incur lower tax rates, given the progressive corporate income tax system. To ensure that our results are not driven by profits, we restrict our sample to include firms with pre-tax income above the sample median and re-estimate Equation (3) based on this restricted sample[25]. The results from the restricted sample (un-tabulated) are qualitatively similar to the full sample results. Thus, for the subset of firms with high level of accounting profits, we still observe an inverse relation between competition and effective tax rates. These results lend more support to the argument that competition enhances tax efficiency (Table X).

7. Concluding remarks

In this paper, we use the US corporate tax management setting to examine the performance consequences of industry product market competition. We find that firms in high-competition industries exhibit lower cash effective tax rates and lower GAAP effective tax rates. This is consistent with the notion that intense competition exerts downward pressure on costs and thus leads to greater tax efficiency.

Further, we find that the relation between industry competition and tax efficiency is stronger for firms with low cash flow volatility. This relation is also more prominent for firms with fewer industry investment opportunities. We also find that the link between industry competition and corporate tax avoidance is weaker for firms with lower level of financial statement comparability. These findings suggest that while firms in competitive

	Dependent variable = *LETR* (1)	Dependent variable = *LCETR* (2)
LHHI	0.090 (2.97)	0.111 (4.18)
ROA5YR	−0.072 (−3.73)	−0.285 (−11.96)
LEV5YR	−0.019 (−1.75)	−0.074 (−5,86)
FI5YR	−0.099 (−1.41)	0.087 (1.05)
ASSETS5YR	0.009 (9.77)	0.001 (1.06)
GROWTH5YR	0.017 (2.20)	−0.041 (−4.37)
RD5YR	−0.176 (−4.85)	−0.237 (−5.58)
PPE5YR	−0.042 (−5.80)	−0.104 (−11.88)
NOL5YR	−0.027 (−5.57)	−0.060 (−10.36)
Intercept	0.313 (26.44)	0.403 (27.82)
Year and Sector	Yes	Yes
R^2	0.056	0.092

Notes: In Column (1), the dependent variable is long-run effective tax rate (*LETR*). In Column (2), the dependent variable is long-run cash effective tax rate (*LCETR*). *LETR* and *LCETR* are measured over the five-year period ending in year *t*. *LHHI* is the average value of the Herfindahl–Hirschman Index over the five-year period ending in year *t*−1. *ROA5YR* is the mean value of return on assets over the five-year period ending in year *t*. *LEV5YR* is the mean value of leverage over the five-year period ending in year *t*. *FI5YR* is the mean value of foreign income over the five-year period ending in year *t*. *LNASSETS5YR* is the mean value of the natural logarithm of total assets over the five-year period ending in year *t*. *GROWTH5YR* is the mean value of sales growth over the five-year period ending in year *t*. *RD5YR* is the mean intangible intensity over the five-year period ending in year *t*. *PPE5YR* is the mean capital intensity over the five-year period ending in year *t*. *NOL5YR* is the mean value of *NOL* over the five-year period ending in year *t*−1. All continuous variables are winsorized at 1 and 99 percent. All variables are defined in Table AI. The sample consists of 35,991 firm-year observations in Column (1) and 33,926 firm-year observations in Column (2). The regressions are pooled regressions with year and sector controls. *t*-Statistic appears in parentheses below coefficient estimates. Robust standard errors are clustered at the firm level

Table X.
Regression of long-run tax avoidance on long-run industry competition

industries place greater emphasis on efficient tax management, their incentives and ability to engage in effective tax planning are constrained by cash flow volatility, industry investment opportunities and financial statement comparability.

Finally, we find that firms in high-competition industries can more efficiently manage taxes than their non-competitive counterparts even in the high-regulation regime. Changes in regulatory and enforcement environments do not alter the relation between competition and the efficiency of tax management. Further analysis reveals that firms in competitive industries are not more likely to use aggressive tax shelters to avoid taxes. Thus, if high regulation and increased enforcement mainly aim to curb abusive tax sheltering, they should have limited impact on efficient tax planning through other channels.

This paper makes several contributions. First, it provides the first documentation on how competition affects tax efficiency for US publicly traded firms. While there is some theoretical support for the general belief that competition enhances firm performance, empirical evidence supporting this view is rather limited. This paper is the first study to examine tax consequences of competition in a developed economy. Second, this paper also contributes to research on corporate tax. The results in this paper are important because they document the association between industry structure and tax efficiency for US publicly traded firms. This link is untested in the prior accounting literature. Finally, given the increasing disparity between statutory tax rates and effective tax rates, the result that intense competition is associated with lower effective tax rates should be of interest to US policy makers.

Notes

1. We use the extent of tax avoidance to measure the efficiency of corporate tax management. Tax avoidance refers to the reduction of explicit taxes through planning activities (Hanlon and Heitzman, 2010). Admittedly, corporate tax management is not limited to tax avoidance. It includes compliance, reporting, risk management for direct and indirect taxes as wells as tax planning and other value-added activities. We focus on the tax avoidance dimension because lowering the tax rates and minimizing cash outflows are always important performance indicators for corporate tax departments.

2. The US tax laws are complicated and have grown tremendously since 1909. The Chinese corporate income tax code was implemented in 1994. The differences in tax rules and tax enforcement between US and China lead to different corporate tax behavior when firms faced with intense product market competition.

3. More specifically, firm owners can observe managerial output but cannot directly observe managerial effort or productivity shocks. Since productivity shocks are correlated across firms operating in the same product markets, the existence of many players in a competitive product market allows firm owners to filter out these productivity shocks and assess managerial performance with greater precision.

4. Consistent with this argument, DeFond and Park (1999) found that poorly performing CEOs are more likely to be removed by the board in highly competitive industries than in less competitive industries. The relationship between CEO turnover and the industry adjusted firm accounting performance is more pronounced in competitive industries.

5. For example, Harris (1998) employed both four-firm concentration ratio and Herfindahl–Hirschman Index to measure the level of industry competition. The Herfindahl–Hirschman Index uses the entire market share distribution in an industry to present a complete picture of industry concentration.

6. Recent work suggests that competition measures constructed from US Census data provide a more complete picture of industry competition than measures constructed from COMPUSTAT data (e.g. Ali *et al.* 2009). While COMPUSTAT data cover only public firms in an industry, US Census data cover both private and public firms in a particular industry and thus should more accurately reflect the level of competition. However, prior research shows that public firms and private firms may have different incentives and costs of engaging in tax avoidance. For example,

public firms are subject to higher financial reporting costs and higher agency costs than private firms. These differences may affect the extent of public firms' tax avoidance and specific tax strategies (conforming vs non-conforming) employed by public firms to lower their tax payments (e.g. Shackelford and Shevlin 2001). Thus, in our research setting, public firms from the same industry form a more meaningful group of competitors.

7. As in Allayannis and Ihrig (2001) and MacKay and Phillips (2005), we assume that there is one-to-one relationship between the industry classification code assigned to a firm by COMPUSTAT and the product market in which the firm operates. Any measurement error created by this aggregation is not likely to systematically vary across industries. Thus, the existence of this measurement error is unlikely to bias our results.
8. Sample size varies for other tests due to additional data requirements.
9. Specifically, firms may choose to locate foreign subsidiaries in low-tax jurisdictions and defer repatriations of foreign earnings. For financial reporting purpose, they may take a position that foreign earnings are permanently reinvested in those foreign jurisdictions.
10. The level of capital intensity may affect the attributes of tax avoidance in a couple of ways. First, capital-intensive firms may lower their tax payments by taking accelerated depreciation for tax reporting purposes; second, capital-intensive firms may have strong incentives and more opportunities to strategically locate their assets.
11. A negative coefficient on *ROA* will be consistent with the notion that more profitable firms have more incentives and resources to engage in sophisticated tax strategies, and thus avoid more tax.
12. Our sample covers firms in the following sectors: mining and construction, manufacturing, transportation, communications, electric, gas, sanitary services, wholesale and retail trade, financials, services and public administration.
13. Inferences do not change if standard errors are clustered at the firm level and the year level.
14. However, in Panel A, where the extent of tax avoidance is measured by GAAP ETR (*ETR*), the coefficient on *GROWTH* is positive and significant. This suggests that growth firms may implement tax planning strategies that result in significant cash tax savings because these firms need to fund growth in a low cost and tax efficient way.
15. The US statutory corporate tax rates remain the same over our sample period 1994–2008. Changes in effective tax rates should be primarily driven by firm fundamentals and tax planning effort.
16. Mills *et al.* (1998) found that their sample firms spend 0.39 percent of total SG&A on tax planning (in-house costs and expenditure for outside assistance).
17. Results are qualitatively similar if high competition is measured by the low four-firm ratio dummy (*D_LOW4FIRMRATIO*).
18. Section 404 of the Sarbanes-Oxley Act of 2002 (SOX) requires a company to perform an annual assessment of the effectiveness of the company's internal controls over financial reporting and to include management's report thereon in its 10K filing. Given the materiality of taxes to virtually all companies, implementing appropriate and effective controls over taxes and managing a process to test the effectiveness of those controls are an important aspect of a company's efforts to comply with the provisions of SOX. The controls implemented in this regard have become foundational to the tax risk frameworks for US companies.
19. In 2004, Schedule M-3 was implemented for return filings after December 31, 2004, to provide the IRS with more efficient reporting and transparency between book and tax reporting.
20. In June, 2006, the Financial Accounting Standards Board issued Interpretation 48 of Financial Accounting Standard 109. This interpretation, known as "FIN 48," is intended to eliminate inconsistency in accounting for uncertain tax positions in financial statements certified in accordance with US GAAP. FIN 48 mandates new rules for recognition, de-recognition, measurement and disclosure of all tax positions.

21. In Column (2), we drop control variables that are used in the sheltering prediction model in Wilson (2009). The results are qualitatively similar to results in Column (1) where those variables are included. Results are qualitatively similar if high competition is measured by the low four-firm ratio dummy (*D_LOW4FIRMRATIO*).
22. We greatly appreciate Rodrigo Verdi for sharing the accounting comparability data.
23. Discussion with tax practitioners indicates that although firms implement tax strategies that quickly increase cash flows and thus have immediate impact on annual *CETR* (e.g. accounting method reviews to defer income and accelerate deductions, quick refunds of current-year estimated tax overpayments, as well as credit and loss carrybacks to recoup tax payments made in previous years), they prefer tax strategies that have multi-year effect and generate sustainable cash savings.
24. Consistent with prior *ETR* research (e.g. Dyreng *et al.*, 2008), we delete firms with non-positive aggregate pre-tax income.
25. Results are qualitatively similar if we restrict our sample to include firms with pre-tax income above $50m or above $100m.

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Further reading

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Slemrod, J. (2004), "The economics of corporate tax selfishness", *National Tax Journal*, Vol. 57 No. 4, pp. 877-899.

(The Appendix follows overleaf.)

Appendix

Table AI.
Variable definitions

ETR	Book effective tax rate, defined as total income tax expense (*TXT*) per dollar of pre-tax book income (*PI*)
CETR	Cash effective tax rate, defined as cash income taxes paid (*TXPD*) per dollar of pre-tax book income (*PI*)
LETR	Long-run effective tax rate, defined as sum of total income tax expense (*TXT*) over 5 years ending in year t divided by sum of total pre-tax book income (*PI*) over 5 years ending in year t
LCETR	Long-run cash effective tax rate, defined as sum of cash income taxes paid (*TXPD*) over 5 years ending in year t divided by sum of total pre-tax book income (*PI*) over 5 years
SHELTER	Estimated sheltering probability, based on Wilson's (2009) tax sheltering model: $SHELTER = -4.86 + 5.20 \times BTD + 4.08 \times \lvert DAP \rvert - 1.41 \times LEV + 0.76 \times AT + 3.51 \times ROA + 1.72 \times FOREIGN + 2.43 \times RD$
HHI	Herfindahl–Hirschman Index, defined as the sum of the squared market shares based on sales of all firms in an industry (2-digit SIC)
4FIRMRATIO	Four-firm concentration ratio, defined as the sum of market shares based on sales of the largest four firms in an industry (2-digit SIC)
LHHI	Long-run Herfindahl–Hirschman Index, defined as the mean of *HHI* over 5 years ending in year $t-1$
L4FIRMRATIO	Long-run four-firm concentration ratio, defined as the mean of *4FIRMRATIO* over 5 years ending in year $t-1$
ROA	Return on assets, defined as pre-tax earnings (*PI*) divided by beginning total assets (*AT*)
LEV	Leverage, defined as long-term debt (*DLTT*+*DLC*) divided by total assets (*AT*)
ASSETS	Firm size, defined as the logarithm of total assets (*AT*)
FI	Foreign income, defined as foreign pre-tax income divided by beginning total assets (*AT*)
GROWTH	Growth, defined as growth in sales (*SALE*) from year $t-1$ to year t
PPE	Capital intensity, defined as net property, plant, and equipment (*PPENT*) divided by beginning total assets (*AT*)
RD	Intangible intensity, defined as research and development expense (*XRD*) divided by beginning total assets (*AT*)
NOL	Tax loss carryforward, measured as an indicator variable taking the value of 1 if the beginning net operating loss carryforward (*TLCF*) > 0, and 0 otherwise
sdCFO	Cash flow volatility, measured as the standard deviation of operating cash flows (*OANCF*) scaled by total assets (*AT*) over a rolling five-year period ending in year t
MB	Market-to-book ratio, defined as the ratio of the market value of equity (*PRCCF* × *CSHO*) to the book value of equity (*CEQ*) at the beginning of year t

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